DOUBLY IONIZED K-SHELL FOLLOWING RADIOACTIVE DECAY

BY

ROSALYN SUSSMAN YALOW

A. B., Hunter College of the City of New York, 1941

M. S., University of Illinois, 1942

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
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IN THE GRADUATE SCHOOL OF THE UNIVERSITY
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Te^{121} (125 days) decays by K-electron capture into Sb^{121}. The X-rays from the tellurium isotope had been investigated by O'Neal and Scharff-Goldhaber[1] whose measurements in the critical absorption region revealed the presence of normal antimony X-rays and, in addition, other X-rays of higher energy. The latter they attributed to a $K\alpha$ satellite which arises from a transition from an L-shell into a doubly ionized K-shell.

Absorption in lead, silver and tin of the radiation from the excited antimony shows the existence of two γ-rays whose energies are 225 ± 10 and 610 ± 10 Kev respectively. These values are in good agreement with those of Hales and Jordan[2], who determined the energies of the internal conversion electrons corresponding to these transitions. The absence of γ-γ, γ-electron and electron-electron coincidences indicates that Sb^{121} is formed in two excited states of 225 and 610 Kev energy. The transition from the upper to the lower excited level is strongly forbidden. A search was made for other γ-rays of energy greater than 10 Kev and less than 1 Mev, with negative results. No appreciable positron emission takes place since, if present, it would have yielded γ-γ coincidences between the annihilation quanta.

The interpretation of the higher energy X-ray given by O'Neal and Scharff-Goldhaber has been confirmed in various ways, and a number of alternative explanations excluded. These experiments required the measurement of coincidences which had previously not been studied: X-X, X-electron and X-X-electron coincidences.

The intensity of the $K\alpha$ satellite is found to be about

[1] R. D. O'Neal and G. Scharff-Goldhaber, Phys. Rev., **62**, 83, (1942).
[2] E. B. Hales and E. B. Jordan, Phys. Rev., **62**, 553, (1942).

30% of the total $K\alpha$ intensity. The satellite is emitted in coincidence with the normal $K\alpha$X-ray of antimony and with the 225 Kev internal conversion electron. It is not emitted in coincidence with either γ-transition or with the 610 Kev internal conversion electron. It is shown that the 27 Kev radiation is neither a tellurium $K\alpha$ X-ray arising from an isomeric transition nor a γ-ray. The possibility that the doubly ionized K-shell arises from the simultaneous ejection of both K-electrons by a hitherto unobserved type of internal conversion is also excluded.

From the intensity of the X-ray satellite and the known time for which a hole in the K-shell persists, approximately 10^{-16} sec, one may conclude that the lifetime of the 225 Kev state is less than 2×10^{-17} sec. For such a fast transition one might expect strong resonance absorption of the γ-rays in antimony, but a careful search revealed none[3]. The internal conversion coefficient of the "fast" transition is found to be unusually high, approximately 0.8, though one K-electron is missing. The properties of this excited state are therefore rather anomalous and may be connected with the fact that the transition takes place while one K-electron is missing.

Since only normal antimony X-rays are observed in coincidence with the higher energy internal conversion electron, the mean lifetime for the 610 Kev level is greater than 5×10^{-16} sec.

[3] G. Scharff-Goldhaber, M. Goldhaber, and R. S. Yalow, Bull. Am. Phys. Soc., **19**, No. 5, 6, (1944).

VITA

Rosalyn Sussman Yalow was born July 19, 1921, in New York, New York. She received her elementary education in the public schools there. In 1941 she received the degree of Bachelor of Arts from Hunter College of the City of New York, and in 1942 the degree of Master of Science from the University of Illinois. From 1941 to 1943 she was an Assistant in Physics at the University of Illinois. During the year 1943-1944, she was a Graduate Fellow at the same University. At present she is an Instructor in Physics. She is associated with Phi Beta Kappa, Sigma Xi, Sigma Pi Sigma, Pi Mu Epsilon, Sigma Delta Epsilon, and the American Association of Physics Teachers.

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